## 1.10.4. RAILWAY TRACKS DISLEVELMENT HYDROACOUSTIC CONTROLS

Yesipov V.N., Orel State Technical University, Orel, Russia

Control over cross dislevelment of the railroad tracks is made during installed rail tracks alignment by flattener – tamper machines. Controls operate in dynamic mode within a wide temperature range and at three – components vibration. Severe requirements applied to Controls with regard to sensitivity, accuracy, frequency band, amplitude and phase error.

One way of improving parameters of direct measurement controls is the use of hydro acoustic sensors. Mechanical part of the system includes the hollow case filled in with two immiscible liquids with different densities or one liquid with installed on torsion suspension or a special support a plate with offset mass center and ultrasonic information logging system. The liquid interface or a plate is used as an ultra sound reflector or as attenuation when ultra sound goes through it.

Alongside with conducted theoretic and experimental studies there had been developed the design basics, schematics and obtained static specifications of single-coordinate and double coordinate dislevelment control sensors of different types [1, 2, 3], some findings shown on fig. 1 and 2.

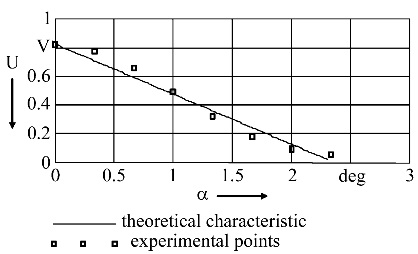


**Fig. 1. Static features of liquid sensor**

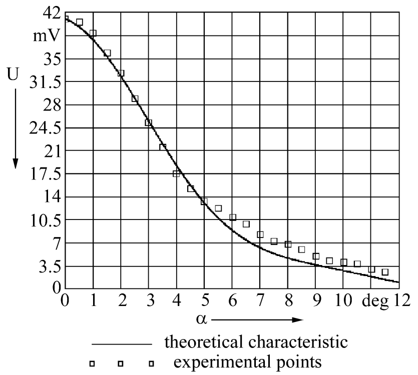


**Fig. 2. Static features of sensor with pendulum plate**

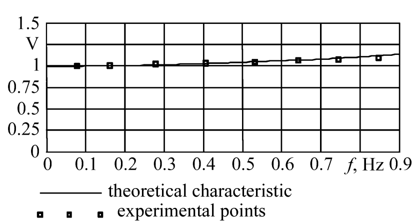


**Fig. 3. Liquid sensor amplitude – frequency response**

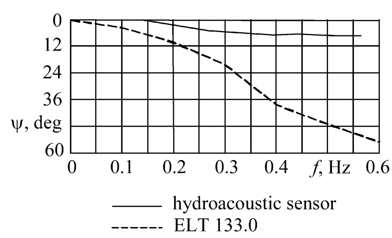


**Fig. 4. Liquid sensor phase – frequency response**

On the base of mathematical modeling of the sensor mechanical subsystem there had been developed generalized differential equations for movement of pendulous subsystem for liquid and liquid mechanical sensors, installed on the base exposed to angular oscillation [4]. Analyzed dynamics specifics of mechanical sensor subsystem installed on vibrating base accounting liner and angular movement of the base. Obtained analytical expressions for sensor dynamics. Liquid sensor predicted and experimental dynamics shown on fig. 3 and 4 [5].

Study of the sensor separate subsystems provided opportunity to develop numerical model, which integrates mechanical and ultrasonic subsystems and thus allowed to design specific sensor samples.

For comprehensive estimate of the sensor accuracy there had been obtained and scrutinized analytic expressions to outline static and dynamic errors. Total error shall be not more than acceptable value of 0.4% in the operating temperature range from –10°C up to +40°C.

Conducted studies proved feasibility of hydro acoustics dislevelment control sensors with required metrological performance. Being much smaller they outdo currently employed device ELT 133.00 (company Plasser & Thurer, Austria) on dynamic features, i.e.: dynamic instability factor in working frequency range is 0.04 – 0.06, it is 4 times less, the highest phase delay is 6.8°, it is 7 times less than with ELT 133.00 device.

**References:**


1. **Yesipov V.N., Yesipov A.V.** Dislevelment hydroacoustic pendular control sensors // Sensors & Systems. – 2003. – N 5. – P. 27 – 30.
2. **Yesipov V.N., Neznanov A.I.** Dislevelment hydroacoustic sensors with mechanical pendular sensitive element // Status & Problems of Measurements / Digest 10 All Russian Scientific Conference, Moscow University, 2008. – P. 54–55.
3. **Yesipov V.N.** Hydroacoustic sensors controlling anglers and angle velocity // Control. Testing. – 2004. – N 9. – P. 52 – 61.
4. **Yesipov V.N., Yesipov A.V.** Math modeling of dislevelment hydroacoustic control sensors // Sensors & Systems. – 2004. – N 1. – P. 15 – 17.
5. **Yesipov V.N., Yesipov A.V.** Metrological features of dislevelment hydroacoustic control sensors // Sensors & Systems. – 2005. – N 1. – P. 42 – 46.